REMARKS

Status of Claims: Claims 1-28 are pending in the present application. Claims 1-28 have been rejected in the Office Action of October 18, 2006. Upon entry of the current amendments, claims 1-28 will be pending. Reconsideration of the Office Action of October 18, 2006 is requested in view of the following remarks.

Response to Interview Summary:

Applicant takes exception with a number of statements that the examiner makes in the Response to the Interview Summary on page 2 of the present Office Action. Applicant respectfully submits that at least the following statements illustrate a misinterpretation of the prior art reference to Ortyn et al.

First, in the second and third lines of the examiner's statement on page 2 of the Office Action, the examiner appears to have misinterpreted Ortyn et al. wherein the examiner states that "in light of a digital gradient filter (or " a filter array" in col. 19, line 53). The "filter array" in col. 19, line 53 of Ortyn et al. is **not** a digital gradient filter, but rather is the array of values containing the smoothing filter. For example, Ortyn et al. describe "[t]he filter array Ffk is selected to provide a finite impulse response, low pass filtering of the focus plus and focus minus arrays." (Ortyn et al. at col. 19, lines 55-57). It appears that the Ffk array is misunderstood by the examiner as being the focus filter, which is not the case.

Further, the apparent misinterpretation of the teaching of the cited reference continues where in the Office Action reads "to obtain a focus score or "array of focus scores" in col. 20, line 62." The filter array Ffk of Ortyn et al. acts on the focus scores, and is **not** used to obtain the focus scores – *i.e.*, they already exist at this point in the algorithm. See Ortyn et al. at col. 18, lines 31-34 and col. 19, lines 52-54.

An important distinction between Ortyn et al. and the claimed invention is that Ortyn et al. disclose and teach smoothing after the focus score has been determined. This is generally not a good practice and results in poor focusing. Another important distinction between Ortyn et al. and the recited claims, the smoothing filter Ffk() in Ortyn et al. is **never** applied directly to the image data – only to the integrated line focus scores. These

distinctions, which were discussed at some length during the Interview of September 14, 2006, are not trivial distinctions.

Furthermore, Ortyn et al. do **not** use "an array of filters" (see Office Action at page 3), but rather stores data in an array to which ONE filter is applied, and hence uses an ARRAY of filter VALUES. For example, Ortyn et al. disclose and teach "The [singular] filter array Ffk is selected to provide a finite impulse response, LOW PASS FILTERING of [both] the focus plus and focus minus arrays." See Ortyn et al. at col. 19, lines 55-57. Applicant notes that Ortyn et al. has to deal with two arrays, one from the above focus camera, one from the below focus camera. This is due to the application (focus quality control) and has nothing to do with the focusing algorithm itself.

Applicant further takes exception with a number of statements contained in the Response to the Interview Summary on page 3 of the present Office Action. Applicant respectfully submits that at least the following statements are incorrect, improper, and illustrate a misinterpretation of the prior art reference to Ortyn et al.

In the first paragraph on page 3 of the Office Action it states "[w]hile such a feature such as the "combined gradient and smoothing operator which caries out both . . . operations in one pass" are not claimed (see "Note" below)." Applicant submits that this statement is incorrect and that these features are claimed (see, for example, step 2 of claim 1 which recites "applying a digital gradient filter . . ., wherein the digital gradient filtering step includes a smoothing operation having a settable spatial extent"). Also, the Office Action continues "the examiner interprets the above mentioned filter array as the above mentioned combination gradient and smoothing operator; however, Ortyn et al. is not clear as the whether the filter array carries out both operations in one pass . . .[h]owever, the examiner believes that Ortyn et al. suggests such a feature since an array of filters is used where one filter of the array can operate or a plurality of filters can operate simultaneously or a patterned sequence of filters can operate in a certain order. Applicant submits that this "belief" on the part of the examiner is improper and not supported by the disclosure and teaching of the Ortyn et al. reference. However, although applicant finds the examiner's reasoning very difficult to follow and believes that this again demonstrates a misinterpretation of the Ortyn et al. reference, applicant provides an explanation below that

applicant hopes will clarify the distinctions between the method taught by Ortyn et al and the claimed invention.

In the second paragraph on page 3 of the Office Action, the examiner "[n]ote[s] that the claimed step 2 is interpreted as "applying (as in claim 1, line 5)" the digital gradient filter and does not apply the claimed smoothing operator within step 2." The examiner continues "[t]hus, only the digital gradient filter operation is only carried out in one pass and includes an inactive or not applied smoothing operation during step 2 which is interpreted as one pass. Applicant first comment to this interpretation by the examiner is that this statement and reasoning is unclear and confusing. Second, applicant submits that this interpretation and method of examination is improper. Claim 1 recites in step 2 that "**the digital gradient filtering step includes a smoothing operation** having a settable spatial extent." The claim language is clear on its face and it is improper for the examiner to "read-out" limitations clearly recited in the claim. Applicant requests that the examiner explain with more clarity his reasoning and also provide a statutory basis for such a methodology for examining patent claims.

In order to expedite examination of the present application, applicant provides the following explanation of the Ortyn et al. reference and the claimed subject matter to hopefully convince the examiner of the illogic of the above reasoning and statements.

The method of Ortyn et al. teaches:

[ALGORITHMIC OUTLINE:]

1) a (band-pass) filter is applied to each line in the image (col. 18. lines 15-17 and lines 42-44) [IMAGE size w*h input, IMAGE output]
2) an energy operator is applied to the filter output [IMAGE input, IMAGE output] (col. 18, lines 17-20)
3) the focus score is integrated for each LINE in the image [IMAGE size w*h input, 1-dimensional ARRAY size h output] (col. 18 lines 20-24).
4) smooth the focus score ARRAY by a filter (col. 19 lines 37 and further) [ARRAY input, ARRAY output]
5) POSTPROCESSING of ARRAY values to deal with noise (col. 20 throughout, col. 21 lines 1-27) [ARRAY input, ARRAY output]
6) integrate ARRAY values to get single focus score (col. 21, lines 27-32) [ARRAY input, SCALAR NUMBER output]

Note the clear separation in Ortyn et al. of band-pass filtering (step 1) and smoothing (step 4) by intermediate steps of a non-linear operator (step 2) and an integration operator (step 3). Hence, Ortyn et al. is very clear that the filter array does not carry out both operations in one pass (as suggested by the examiner on page 3 of the Office Action).

In contrast, the claimed method of the present application includes:

[EXEMPLARY ALGORITHMIC OUTLINE:]

1) a smoothing and derivative filter is applied to the image
[IMAGE size w*h input, IMAGE output] [CLAIM 1]

2) a energy operator is applied to the filter output
[IMAGE input, IMAGE output] [embodiment]

3) the focus score is calculated for the whole image
[IMAGE input, SCALAR NUMBER output] [embodiment]

As such, the independent claims recite smoothing and differentiation in a single filter step. The present invention results in a simpler, yet more robust algorithm than the method taught by Ortyn et al.

__Claim Rejection -35 USC §102:__

Claims 1, 2, 4-12, 14-20, 22, 23 and 25-28 are rejected under 35 U.S.C. 102(b) as allegedly being anticipated by Ortyn et al. (US Patent 5,841,124). According to the Office Action, Ortyn et al. discloses all the features of the rejected claims. This rejection is traversed.

As a preliminary matter, it is respectfully submitted that the examiner does not fully understand the technology disclosed in the prior art reference, or the technology covering the claimed subject matter, or fully appreciate the meaning of various claim terms. For example, and as explained during the Interview of September 14, 2006, a low pass filter **applied** to the (integrated) focus scores and a high pass filter to **obtain** the focus score are not the same thing structurally nor do they perform the same function. One skilled in the art would understand that a low pass filter acting on the (integrated) filter scores, such as the band-pass disclosed in Ortyn et al., would not be suitable in place of the claimed digital gradient filter,

which is a specific type of high-pass filter that combines smoothing and differentiation on the image data.

The standard for anticipation under 35 U.S.C. §102(b) is one of strict identity. An anticipation rejection requires a showing that each limitation of a claim be found in a single reference, *Atlas Powder Co. v. E.I. DuPont de Nemours & Co.*, 224 U.S.P.Q. 409, 411 (Fed. Cir. 1984). The current grounds for rejection of the claims can not stand because Ortyn et al. fail to disclose each and every limitation of the independent claims and therefore there can be no anticipation of the claims under 35 U.S.C. §102(b).

The disclosure by Ortyn et al. is directed to an automated method for checking cytological system autofocus integrity. According to Ortyn et al., the automated method includes the steps of checking focus illumination integrity, checking focus camera Modulation Transfer Function, checking focus camera position integrity, and checking closed loop accuracy.

As such, Ortyn et al. is directed to a quality control system for validating automated microscopy systems for autofocus performance. The cytological system autofocus integrity checking system disclosed by Ortyn et al. evaluates the optical performance of a microscopy based system and, as disclosed, is not another autofocus system in and of itself. In addition, Ortyn et al. disclose and teach a practical means for conducting a performance evaluation, but do not disclose details of the autofocus algorithm and implementation itself. For example, Ortyn et al. do not disclose the use of the first order Gaussian derivative in a real-time image driven autofocus system.

Ortyn et al. disclose a digital band-pass filter (see Fig. 15, numeral 404/406; col. 18, line 13). A digital band-pass filter can include almost anything, and the choice may be from thousands of options. Performance of autofocus is affected by the type of filter selected.

The selection of a suitable filter that provides optimal performance during autofocus using different microscopic modes is one of the problems that the present invention seeks to overcome. (see application page 1-4). In contrast to Ortyn et al., the claimed invention includes a digital gradient filter, which is a high-pass filter of a specific type, that provides improved performance over other types of filters, such as the digital band-pass filter of Ortyn et al. This feature of the present invention is recited in, for example, independent claim 1, step 2: "applying a digital gradient filter . . ."; independent claim 11, line 4: ". . . the

autofocus mechanism having a digital gradient filter . . ."; independent claim 22, line 4: ". . . a digital gradient filter . . .".

Also, the recited digital gradient filter includes a zero crossing at the origin by definition (see also claim 3). The region around the zero-axis is specifically excluded as being relevant in the filter design as proposed by Ortyn et al. (see *e.g.*, Fig. 22). Hence, the specific proposed filter design in the present application is not even included in Ortyn et al.'s quite general teaching of filter design (as outlined in Figs. 20-22).

Furthermore, the claimed digital gradient filter includes a smoothing filter where the spatial extent (smoothing size) of the filter is settable. This feature is also recited in independent claims 1, 11, and 22. For example, independent claim 1, line 7: ". . . a smoothing operation having a settable spatial extent . . ."; independent claim 11, lines 6-7: ". . . a smoothing operation having a settable spatial extent . . ."; independent claim 22, lines 5-6: ". . . a smoothing operation having a settable spatial extent . . .".

In contrast, the filter 404 in Fig. 15 of Ortyn et al. does not disclose smoothing with settable size. In addition, the cytological system autofocus integrity checking apparatus disclosed by Ortyn et al. smoothes the focus score, that is the output F+ and F- as shown at the right of Fig. 15. The method disclosed by Ortyn et al. has drawbacks as compared with the claimed subject matter of the present application with respect to, for example, noise sensitivity.

The method disclose by Ortyn et al. requires noise sensitivity to calibrate and threshold (see Ortyn et al. at col. 20). In contradistinction, the claimed invention of the present invention does not require such an effort, as noise is already averaged inside the claimed filter before constructing the focus score. This feature provides an autofocus method that is robust against confounding factors common in microscopy, such as noise, optical artifacts, and dust on the preparation surface.

Ortyn et al. disclose band-pass filtering 404, energy operator 408, and smoothing the function score afterward. The combination of band-pass filtering 404, energy operator 408, and smoothing afterward as disclosed by Ortyn et al. is structurally and mathematically different from digital gradient filtering with smoothing, and afterward energy operator, as recited in the claims 1, 11 and 22 of the present application. For example, the extra step of noise cancellation and calibration disclosed and required by Ortyn et al. is not necessary in

the present invention.

Hence, independent claims 1, 11, and 22 of the present invention are not anticipated by Ortyn et al. because the Ortyn et al. reference does not disclose all of the limitations recited in those claims. In addition, claims 2, 4-10, 12, 14-20, 23 and 25-28, which depend direct or indirectly from independent claims 1, 11, and 22, are also allowable over Ortyn et al. for the reasons stated above with respect to independent claims 1, 11, and 22. Accordingly, withdrawal of the rejection of claims 1, 2, 4-12, 14-20, 22, 23 and 25-28 under 35 U.S.C. 102(b) is requested.

Further and with respect to claims 1, 2, 12 and 22, Ortyn et al. sets the spatial extent of smoothing over focus scores to be compatible with the biological structures under study (e.g., cell nuclei). In contrast, the claim method of claims 1, 2, 12 and 22 comprises a generic smoothing step, the size being chosen to capture image details like edges. Hence, the claimed method does not have to be tuned to the biological preparation at hand. Rather, the claimed method tunes the filter to the camera characteristics and imaging conditions, independent of the biological specimen under consideration.

Furthermore, the claimed method only needs to tune one parameter for any setup. Ortyn, on the other hand, needs to design a new band-pass filter for each new biological application. This is a non-trivial task, for which Ortyn et al. dos not provide a recipe other than "using conventional techniques." Given the enormous amount of filter literature, one can hardly speak about conventional technique. Again, the claimed method allows tuning one parameter, which is an improvement over existing filtering methods.

The claimed subject matter of claims 1, 11 and 22 includes "contrast" filtering, which allows for autofocusing wherein prior knowledge of the object's features are not required. Contrast filtering is different than "size" filtering, which is type of filtering disclosed in Ortyn et al. The claimed invention uses contrast information to estimate goodness-of-focus (*i.e.*, by a focus score). Contrast is measured by the claimed "digital gradient filter." Use of a digital gradient filter allows filter size to be tuned to optical characteristics of the imaging set-up resulting in a steeper slope and hence better focus.

Withdrawal of the rejection of claims 1, 2, 12 and 22 is requested for this additional reason.

Still further and with respect to claims 4, continuous motion is another essential difference and innovation with respect to existing autofocus systems. Ortyn et al. describe a z-pan focus (col. 15, line 19): "A z-pan focus is performed under control . . . at step 132. A z-pan focus refers to a focusing procedure in which a sample is scanned in the z-axis, that is along the optical axis, preferably through the focal plane of the optical system." Then Ortyn et al. disclose "[a]t predetermined increments during the scan, . . .", which implies a "stop and go" mechanism to capture at these predetermined positions.

In contrast, the claimed method of autofocus applies a timing methodology – that is it sent away the microscope motor to travel from above focus to below focus, without any further control on positioning (see claim 4, step 4 "continues moving the object relative to the optical instrument along the optical axis thereof). At the same time, the claimed method asynchronously starts capturing images. We use the timing of the captured images and assume linear movement along the z-axis to connect each captured image to a z-position, from which the optimal focus position is derived. Hence, the autofocus method of claim 4 does not have predetermined positions, but completely adapts to the (more or less random) times at which images are captured.

Withdrawal of the rejection of claim 4 is requested for this additional reason.

Claim Rejection -35 USC §103:

Claims 3, 13, 21 and 24 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Ortyn et al. (US Patent 5,841,124) in view of Hartman (US Patent 4,592,089).

Hartman fails to remedy the deficiencies of the above-noted Ortyn et al. reference. For the Examiner to make a rejection based on obviousness, 35 U.S.C. § 103(a) and MPEP § 2141 require adherence to the following tenets of patent law: (A) The claimed invention must be considered as a whole; (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination; (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention and (D) Reasonable expectation of success is the standard with which obviousness is determined.

To establish a prima facie obviousness, MPEP §2142 requires there must first be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references when combined must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.

Accordingly, Applicants submit that combination of Ortyn et al. and Hartman fails to establish a *prima facie* case obviousness because the combination does not teach or suggest all of the claim limitations. As such, there is no reasonable expectation of success.

As noted above, Ortyn et al. do not disclose or teach the features of the independent claims from which claims 3, 13, 21 and 24 depend and for that reason it is respectfully submitted that these claims are in condition for allowance and withdrawal of the rejection of these claims under 35 U.S.C. 103(a) is requested.

Further and as admitted by the examiner in the Office Action, Ortyn et al. do not teach the remaining limitations of claims 3, 13, 21 and 24. The examiner does allege that Ortyn et al. teach that the low pass filter can be "designed to be sensitive... to size" in col. 19, line 58 and thus, the examiner reasons that Ortyn et al. suggests to one of ordinary skill in the art a plurality of teachings that can used to create the low pass filter. For the reasons provided above, applicant disagrees with this allegation and traverses it.

The Office Action alleges that Hartman teaches a low pass filter or "median filtering"[1] in col. 11 , line 39 that "removes high-frequency" in col. 11, line 39 or "point noise without boundary smoothing" or "spot radii" in column 8, TABLE 11, labels MEDSM and RADFLT that is sensitive to size or a "radius" in col. 11, line 41. Thus, according to the examiner, the median filter is interpreted to remove the point noise via a smoothing operation and retain the boundary by not smoothing or removing the boundary) that could be used during the design of the low pass filter and the remaining limitation of:

a) a mathematical smoothing function (or "median filtering" in col. 11, line 39 as shown in column B ,TABLE II, label: MEDSM and RADFLT) having a negative and

---

[1] Applicant reiterates that low-pass filtering, such as disclosed by Ortyn et al. (*i.e.*, digital band-pass filter) and Hartman (*i.e.*, median filter), is different from the claimed digital gradient filtering.

positive lobe around the origin thereof (via a differential in table 11, label: CSDIF that includes an "origin" in col. 1010, line 33 as shown in fig. 10), the mathematical smoothing function having only one zero crossing (as shown n fig. 10) and being limited in spatial extent (as shown in fig. 3,num. 45) in that it extends over a distance equal to the image size and extends (as shown in fig. 10 to the left and right towards the horizontal axis) at least over three pixels either side of a pixel whose value is being filtered (since fig. 3,num. 45 is a 60 x 60 window in TABLE II, label: WINDIN).

Applicant submits that this generalization and random citing to Hartman fails to establish a *prima facie* case of obviousness. The examiner has failed to identify where the specific features recited in the claims are allegedly disclosed or taught by the Hartman reference and the cites to Hartman do not disclose the recited features. For example, claim 1 step 2 recites "applying a digital gradient filtering step which includes a smoothing operator with settable spatial extent." Hartman does not disclose the claimed combined gradient and smoothing filter, as the smoothing step (TABLE II MEDSM) and derivative filter (TABLE II CSDIF) in Hartman are separated by the non-linear operator of taking a polar cross section (TABLE II CS). One skilled in the art would understand that derivative filter acting on a polar cross section, as disclosed in Hartman, would not be suitable in place of the claimed digital gradient filter, which combines smoothing and differentiation on the image data.

Accordingly, for at least the reasons noted above, Applicants respectfully request that the Examiner reconsideration and withdraw the rejection of claims 3, 13, 21 and 24 under 35 U.S.C. § 103(a).

CONCLUSION

It is respectfully submitted that each and every claim pending in this application patentably defines over the prior art of record. For all the foregoing reasons, Applicant respectfully submits that the instant application is in condition for allowance. Reconsideration of the present Office Action and an early Notice of Allowance are respectfully requested.

Date: April 18, 2007

/Michael K. Jones/
Michael K. Jones
Registration No. 41,100

Woodcock Washburn LLP
Cira Centre
2929 Arch Street, 12th Floor
Philadelphia PA 19104-2891
Telephone: (215) 568-3100
Facsimile: (215) 568-3439